ASC-232

University of Kentucky
College of Agriculture,
Food and Environment
Cooperative Extension Service

Raising Replacement Pullets for Small-scale Egg-production Enterprises

Jacquie Jacob and Tony Pescatore, Animal and Food Sciences

Introduction

Poultry producers who raise their own replacement pullets have better control over the growth, condition, and development of the flock. The quality of the pullet flock will have a direct effect on the subsequent level of egg production. The two most important quality factors for a replacement flock are proper body weight and uniformity. Pullet weight at 6 weeks of age has been shown to influence subsequent egg production. Once the pullets start to lay, it is too late to solve problems from poor nutrition or management during the pullet-rearing period.

Source of Chicks

It is important to start with healthy chicks. It is strongly recommended that you purchase your chicks from an NPIP (National Poultry Improvement Plan) certified hatchery. If you are importing the chicks into the state, this is mandatory for crossing state lines. Kentucky also requires that the hatchery be NPIP certified as Avian Influenza clean.

When you purchase chicks you have a few options for chick processing. It is strongly recommended that your day-old chicks be vaccinated for Marek's Disease. This is done at the hatchery. If you are going to be floor rearing your chickens, it is also good to get a coccidiosis vaccination, also at the hatchery. The vaccine is sprayed onto the chicks during processing and helps them develop resistance to the parasite that causes coccidiosis. The hatchery can also beak trim your chicks if you would like, and are not raising organic pullets. Beak trimming is done to prevent feather pecking and cannibalism when the pullets are older. Feather pecking can be a problem in any time of housing system, including free-range production. However, a high quality job on each bird must be done to prevent problems as adults.

Housing

Make sure you have sufficient space for the number of chicks you order. You will need at least 0.5 square feet per chick up to four weeks of age. For four to eight weeks of age, one square foot per chick is required. Make sure that the house is well-ventilated, and without any drafts.

It is important to provide chicks with bedding material. Never use smooth, slick surfaces such as flat cardboard or newspaper since they can lead to leg problems. The bedding material needs to be clean, free of mold, and dry but not dusty. The preferred bedding material is kiln-dried hardwood shavings, typically pine shavings. Kiln dried, hardwood sawdust can also be used, although not recommended for chicks since they may confuse it for feed. An alternative bedding material used by commercial producers in some parts of the state is rice hulls. Ground corncobs have been successfully used, as has hay. Straw is not recommended unless it is chopped into 1-inch-long pieces. Three to four inches of bedding material should be put down before the chicks arrive.

It is important that the chickens be provided sufficient feeder and waterer space so that all the chickens can eat at the same time. This will allow for uniform growth rate for all the chickens in the flock. The feeders need to be changed as the birds get older. The feeder in Figure 1 is good for chicks for the first couple of weeks, but then it is necessary to change to a bigger feeder, such as the one

Figure 1. Chick feeder.

Figure 2. Feeder for older chicks.

Figure 3. Typical gallon waterer.

Figure 4. Nipple drinkers.

in Figure 2. The gallon waterer in Figure 3 and the nipple drinkers in Figure 4 can be used for chickens of any age. Make sure all the equipment is clean and disinfected before the chicks arrive.

Brooding

Brooding refers to the provision of artificial heat and specialized care for chicks. Young chicks are not able to regulate their own body temperature, which is 104°F. As a result, you need to provide chicks with supplemental heat for the first 4-6 weeks of age. If brooding in the winter, this time period may need to be extended. Heat must be supplied until the chicks are well-feathered. This will vary between breeds and strains.

There are two types of brooding systems. The first is whole house brooding which, as the name implies, involves heating the whole house. The second and, the most commonly used system, involves directing heat to only a small area.

Many of the larger operations used propane brooders. This requires a reliable source of gas. Smaller producers typically use infrared heat lamps. Red infrared heat lamps are preferred over white, especially for replacement pullets. As will be discussed later, chickens come into lay with increase daylength. It is necessary to maintain only eight hours of light per day during the rearing period. The white heat lamps make this difficult. Make sure they are the Pyrex-type and have a porcelain socket and a lamp guard. A single 250-watt lamp is sufficient for 50-75 chicks.

Figure 5. Heat lamp incorrectly used – a fire hazard

Whatever heat source you choose to use; it must be adjustable. For heat lamps this means raising or lowering the bulb. It is typically hung 1 to 1½ feet above the chicks. It is extremely important that the heat lamps be hung securely. Many poultry houses are lost each year due to heat lamps falling into the bedding material. Chicks will perch on any hanging electrical cords and can bring the heat lamp down, so make sure that perching is not possible. Use a safety chain and never hang the heat lamp by its cord. The lamp in Figure 5 is a fire hazard. Make sure that the heating system is functional before the chicks arrive. If using a heat lamp, make sure you have a spare bulb.

The chicks are typically brooded in an area around the heat source, surrounded by a brooder guard (see Figure 6). The brooder guard prevents the chicks from wandering away for the heat source and getting chilled. The circular nature of the brooder guard also eliminates corners, which reduces the potential for piling when the chicks are startled. Commercial brooder guards are typically corrugated cardboard about 12 inches tall. The brooder guard is typically placed about 6 feet from the heat source. The size of the ring should allow the movement of chicks to and away from the heat source to allow them to regulate their body temperature. The feeders are then laid out like the spokes of a wheel, with the waterers in between the feeders (see Figure 7).

Typically, the temperature is started at 90-95°F for the first week. The temperature is reduced by 5°F weekly until about 70°F. The temperature should be monitored daily, and taken at chick level. The use of a maximum/minimum thermometer is always a good idea so that you can make sure that the temperature does not go too low overnight.

While it is important to monitor brooding temperature daily, the best test for the comfort of the chicks, is chick behavior. When the temperature in the poultry house is correct (Figure 8a), the chicks will be spread out throughout the brooding area. They will move toward and away from the heat as they prefer and will access the feeders and

Figure 6. Layout of feeders and waterers around a brooder guard.

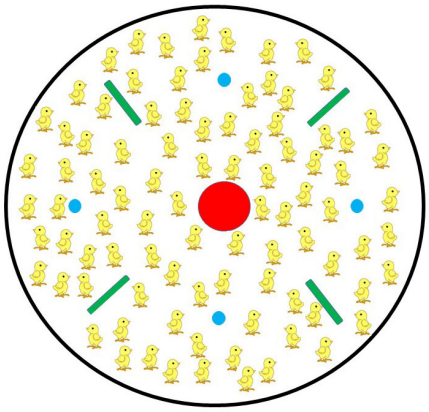

Figure 7. Diagram showing the distribution of the feeders and waterers around the heat source.

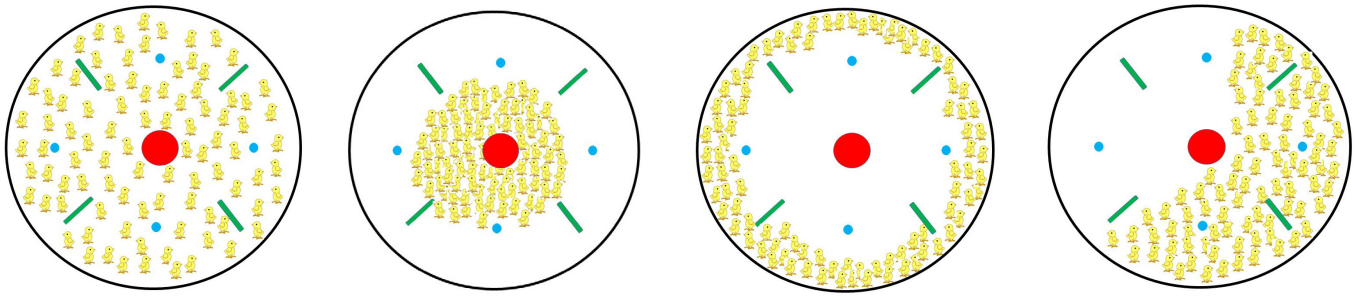

Figure 8. Comparison of the behavior of chicks in a brooder ring during different environmental conditions: a. ideal conditions, b. too cold, c. too hot, and d. draft.

waterers. If the temperature in the poultry house is too cold (Figure 8b), the chicks will huddle together trying to get as close to the heat source as possible. The solution is to increase the temperature. If the temperature in the poultry house is too hot (Figure 8c), the chicks will try to get as far away from the heat source as they can. The solution is to decrease the temperature. If the chicks are avoiding a particular area of the poultry house there may be a draft (Figure 8d). The solution is to correct the problem at the source of the draft.

Before placing the chicks, examine them to confirm that they have well-healed abdomens (where the yolk sac was taken into the abdomen before hatch). If you have a small flock, you can check each chick. For a large flock, a random selection of chicks from each box is sufficient.

When the chicks are first placed it is important that they learn to drink. Dehydration is the most common cause of death in young chicks. The best way to teach the chicks to drink is to dip their beak in the water when using open source waterers (Figure 9). If using nipple drinkers touch the beaks of the chicks to the nipples (Figure 10). You should teach every chick where the water is. If the flock is large, you will need to do it for at least ¼ of the chicks in each box. Leave the lights on all day and night for the first 2-3 days. This will give the chicks time to learn where the food and drink are. After that, there should be a period of dark so that the chicks become acclimated to the dark.

Figure 9. Teaching a chick to drink from gallon drinker.

Figure 10. Teaching a chick to drink from a nipple drinker.

It is important that the chicks start eating. To confirm that the chicks are eating, handle them at 48 hours to access the crop fill. The crop should feel soft and round. If the crop is empty they have not found feed and this needs to be corrected as soon as possible.

It is important to adjust the feeder and waterer size as the chicks grow. As the chicks grow, the feeders and open waterers should be placed at the height of the back of the chicken. Nipple drinkers should be placed above the chicken so that they have to reach for the nipple. This mimics how the chicken drinks naturally. Monitor feed and water consumption daily.

Brooding Checklist

BEFORE THE CHICKS ARRIVE

- Source your chicks from an NPIP-certified hatchery.
- Make sure that all the equipment is working and any needed repairs have been completed.
- Prepare the poultry house at least 24 hours ahead of time.
  - Turn on the heat source
  - Place 3-4 inches of bedding material on the floor/ground.
  - Layout the brooding area including the feeders and waterers.

DAY THE CHICKS ARRIVE

- Check the chicks for quality, including well-healed abdomens.
- Dip the beaks of several chicks into the waterer, or against the nipple drinkers. Again, if you have a small flock you should do this for every

chick. If the flock is larger, you will need to do it for at least ¼ of the chicks in each box.
- Leave the lights on all day and night for the first few days. This will give the chicks time to learn where the food and drink are.
- Make sure the chicks have easy access to feed.

AFTER 48 HOURS

- Handle the chicks and evaluate crop fill to ensure that the chicks are eating.
- If the chicks are eating, reduce the number of hours of light to 20 hours per day.

AFTER 7 DAYS

- Remove the brooder guard.
- Reduce the number of hours of light per day as required by the lighting program.

Light Intensity

During the first few days it is important to have full light intensity. This will give the chicks time to learn where the food and water are and get them off to a good start. After that the light intensity should be reduced. High light intensity can lead to feather pecking and cannibalism. It is important to have sufficient light in the brooder room.

Light intensity is an important consideration when selecting light bulbs for your poultry house. Light intensity is measured in lux or foot candles. In general, 5 lux is too dark to stimulate proper growth and production, while higher than 50 lux may cause nervousness and behavior problems. As the intensity of light required can change during the growing period, dimmable lights can be a good idea in growing houses for replacement pullets. Alternatively, strings of light on different controllers can be used and a different number of lights turned on to adjust the light intensity.

Chickens are also sensitive to the type of light. Domestic poultry see and respond to a different range of light color spectrum than humans. While humans respond to light in the 400-750 nm wavelengths, chickens are able to see this light range plus a bit more. They are able to see ultraviolet (UV) light in the 315-400nm range. In addition, the magnitude of the sensitivity for red and blue light is much higher for chickens than for humans. This must be taken into consideration when selecting the types of lighting. It is important to consider the light spectrum given off by a light source.

Figure 11. Compact fluorescent light bulbs.

A variety of different light sources can be used. In the past incandescent bulbs were used. As these are being phased out, they have been replaced with compact fluorescent (CFL) bulbs (see Figure 11) and, more recently, LED lights. CFL bulbs are more efficient than incandescent bulbs. The spectrum of light of CFLs is similar to incandescent bulbs. They have been proven successful in layer and breeder flocks. Unfortunately, they contain mercury and require special disposal procedures. LED lights can provide a full spectrum of light. They are also the most efficient light bulb, measured as lumens per watt. Unlike the other bulbs, LEDs can be made out of non-glass materials so they can be waterproof and shatterproof. LEDs are also easier to dim than CFLs but the output from the bulbs may decrease with age requiring frequent monitoring of the light intensity in houses lit by LED bulbs. Although a more expensive option, poultry-specific LED lights are available that are well suited for poultry vision. These lights are also typically rated to withstand cleaning and disinfection procedures in a chicken house. Standard household LED lights are typi-

cally not recommended for poultry houses. Such bulbs are not rated for use at 14-16 hours per day as required in layer houses.

Lighting Program

Light is an essential part of egg production. Chickens lay in response to day length. That is, the number of hours of light in the day. Pullets will typically come into production with increasing day length and hens will go out of production with decreasing day length. Pullet chicks are typically raised with a restricted amount of light per day. When they reach sufficient size and maturity to start laying eggs they are given increasing hours of light per day. This will stimulate them to come into egg production. The number of hours of light is increased to 14-16 hours per day and maintained at this level for the remainder of the laying cycle. It is for this reason that supplemental light is necessary.

A typical lighting program for pullets is to start with 20 hours of light per day, bracketing normal day length and then decrease by one hour each week until 10 hours are reached. The day length is maintained at 10 hours per day until the pullets are moved to the layer house and are light stimulated to come into production. A typical lighting program is shown in Figure 12.

In open housing, the artificial lighting program must complement the natural day length and may result in necessary modifications to the lighting program. After the initial step down in hours of light per day during the first 10 weeks, the artificial lights are set to the longest natural day length (including dawn and dusk) the flock will experience during the growing period. This will negate any influence that the natural day length would have on pullet development and stimulation of sexual maturity.

To do this you will need to know:

- **Longitude and latitude of your farm**. If you do not know the position, you can obtain them at http://www.findlatitudeandlongitude.com/
- **Time zone relative to UTC** (-5 for Eastern/Central Kentucky and -6 for Western Kentucky)
- **Times for sunrise and sunset at your location**. This can be determined at https://gml.noaa.gov/grad/solcalc/ using the location and time zone data obtained.

The schedule for artificial lights will vary depending on what part of the year the pullet chicks are first placed.

For example, at the map coordinates below the charts in figures 13, 14, and 15 can be obtained.

- Latitude: 38.094626°
- Longitude: -84.536533°

The longest day of 2018 at this location is June 21 with 14.8 hours of light. Sunrise will be at 5:15 a.m. and sunset at 8:04 p.m. If you place pullet chicks on January 30, 2018, sunrise will be at 7:44 a.m. and sunset will be at 5:58 p.m. for 10.2 hours of light. The hours of light in the day will be increasing during the rearing period. Constant amount of light is desired until the pullets are

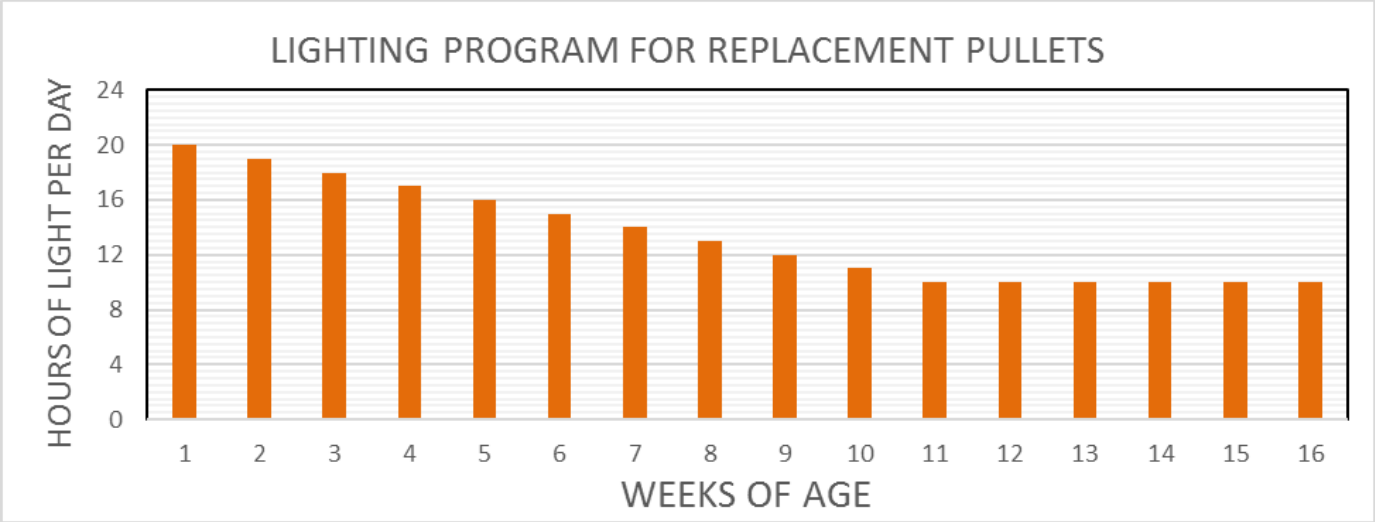

Figure 12. Lighting program for closed pullet houses.

ready for light stimulation, around 16 weeks of age (May 22, 2018). At that time there were will be 14.4 hours of light, with sunrise at 5:22 a.m. and sunset at 7:47 p.m. This means that you will need to maintain the hours of light per day to 14.4 hours during the rearing period. Set the light clock to come on at 5:22 a.m. and go off at 7:47 p.m. Using a light sensor on the light socket will permit the light bulb to only be on when there is not enough natural daylight. Figure 15 shows the distribution of light sources throughout the course of the day. To light stimulate you need to increase the amount of light per day. It is important to make adjustments at both ends of the time clock because the sunrise will be earlier each day and sunset later. Because of the amount of natural light in the rearing period, you will need to increase the amount of light per day to 16 hours and maintain it at that amount during the production cycle.

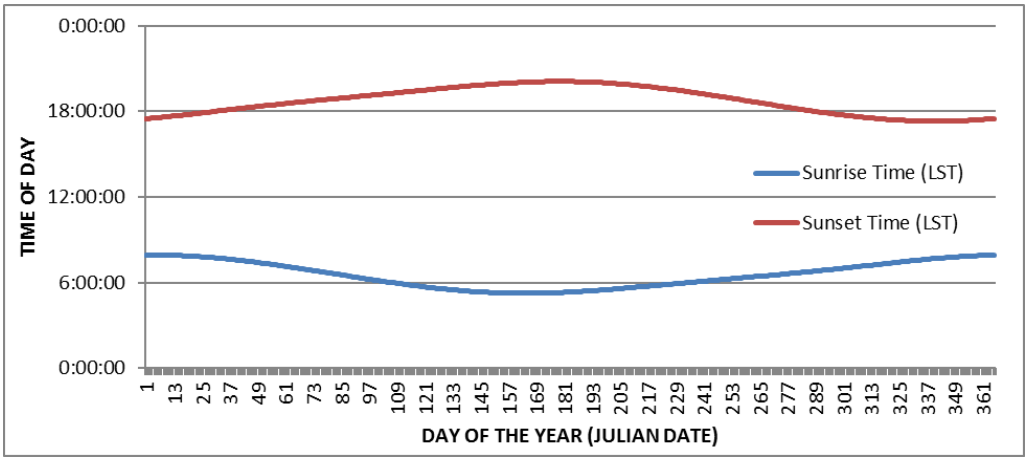

Figure 13. Times for sunrise and sunset for 2018 based on specific map coordinates.

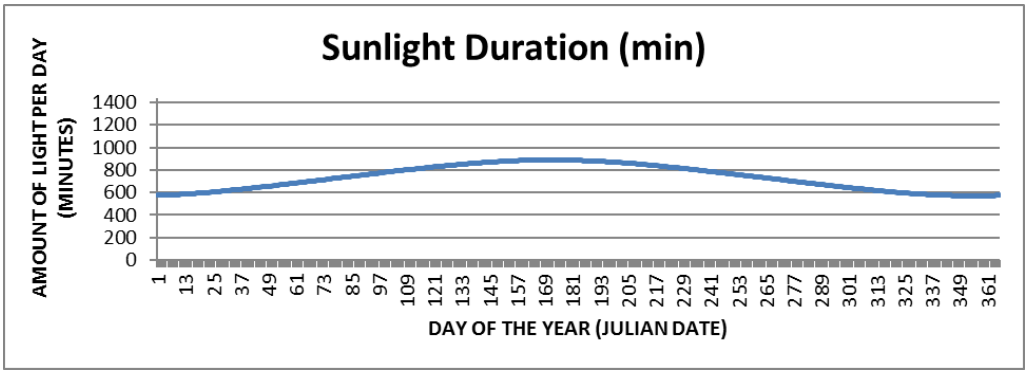

Figure 14. Duration of sunlight per day based on specific coordinates.

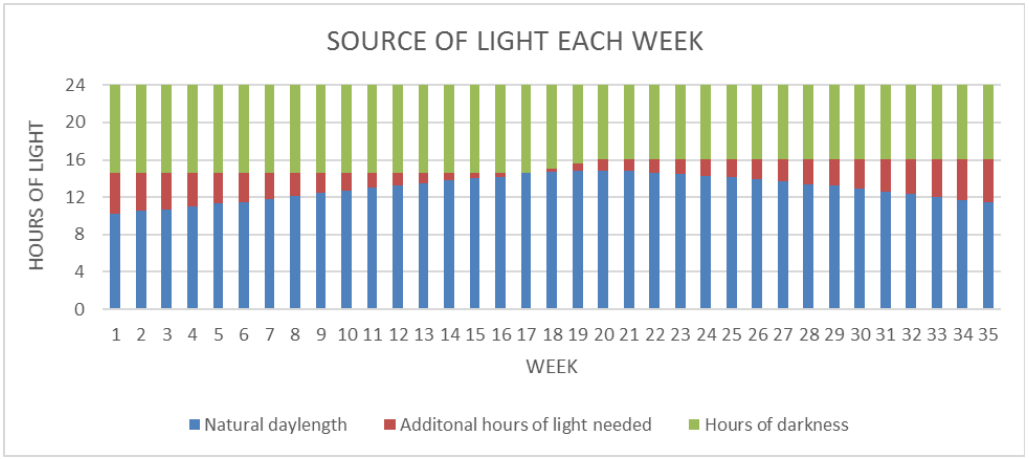

Figure 15. Light requirements for rearing replacement pullets and light stimulating for egg production.

Feed

Diets are formulated to meet the nutritional requirements of the type, age, and production level of each group of chickens. It is important to feed the correct feed for growing replacement pullets. Many large commercial operations phase feed which involves giving different diets depending on the age of the flock. Many breeder production manuals recommend 18.25% crude protein (CP) for starter 1, 20.0% CP for starter 2, 17.5% CP for grower, and 16.0% CP for developer. Some also recommend a pre-lay diet which is higher in calcium than the starter and grower diets to help the pullet prepare for egg laying. If you feed an 18.25% CP or higher during the brooding of the chicks, and you are not able to purchase the variety of feeds dis-

cussed above, you can maintain this feed through the growing period, as long as the flock is able to meet the target weights with good uniformity. For more information, see ASC-233: "Feeds and Feeding for Small-scale Egg-production Enterprises."

Body Weight

Pullets are raised to reach a target body weight by a specific age. That age is usually determined by the breeders. Advances in genetic selection over the last few decades have resulted in a pullet that lays more eggs and comes into production earlier. Each tissue and organ in a pullet develops at different rates. As a result, variations exist throughout the growing period with respect to nutritional needs of the flock. Early in development, high protein organs like heart, liver and kidney are being developed. This is why starter diets are typically higher in protein than grower or developer diets.

The goal is to reach the weekly target weights determined as optimum by the breeder. For example, Hy-line Brown pullets should be 0.8 lbs.

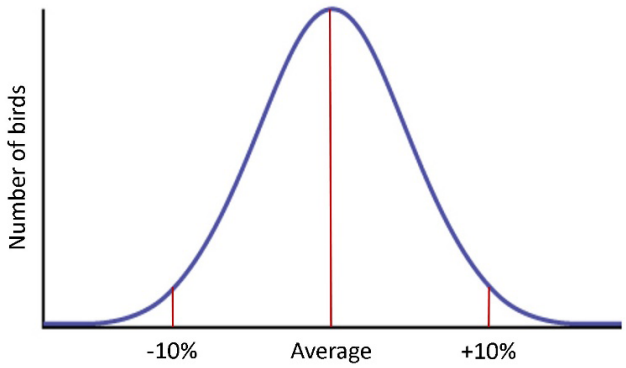

Figure 16. Example of Determining Flock Uniformity

Number of chicks weighed = 100
Average body weight = 2.10 lbs.
10% of average body weight = 0.10 x 2.10 = 0.21 lbs.
Upper body weight = 2.10 + 0.21 = 2.32 lbs.
Lower body weight = 2.10 – 0.21 = 1.89 lbs.
Number of birds with a body weight between the upper and lower weights = 82
Body weight uniformity = number of birds in weight range (82) ÷ number of birds weighed (100) x 100 = 82%

by 5 weeks of age, 1.96 lbs. by 10 weeks and 2.86 lbs. by 15 weeks of age. It is important to monitor flock body weights, including uniformity of weights within a flock. You should individually weigh a random sample of pullet chicks weekly beginning at two to three weeks of age. The goal is to have an even distribution of 80% of the pullets weighing within ±10% of the mean weight of the chicks weighed. See the example in Figure 16.

If the uniformity is below 80% you need to try to remedy the situation. The problem is frequently a shortage of feeder and/or waterer space. If increasing space does not improve the situation, it may be necessary to divide the pullets into separate groups based on weight and adjust the feed given.

Vaccination Program

There are several diseases that can be prevented by vaccination. The vaccine works by activating the bird's immune system to produce antibodies against the disease-causing organism so that the bird's defenses are ready to fight if they should be exposed to the organism.

There are different types of vaccines. Live, attenuated vaccines contain a version of the disease-causing organism that has been modified (attenuated) so that it can no longer cause the disease. Such vaccines typically need to be refrigerated. Although they elicit a good immune response, if not handled correctly, the vaccines can actually cause the disease. This is because the attenuated organism mutates and converts back to its active form. This is the case for the vaccine for Infectious Laryngotracheitis, which is why this vaccine is strongly regulated in the U.S.

Inactivated vaccines are produced by actually killing the disease-causing organism using chemical, heat or radiation. Because they are dead, the organisms cannot revert back to a disease-causing state. The vaccines are typically stored and transported in a freeze-dried state so refrigeration is not necessary.

Recombinant vaccines are made from an attenuated virus or bacteria to which microbial DNA from the disease-causing organism has been added. It is this microbial DNA that causes the immune response.

The decision of which vaccines to use will vary

depending on the location of the flock, and what diseases, if any, are prevalent in the area. The schedule of vaccines selected will depend on the disease exposure expected, level of maternal antibodies in the young chick, the type of vaccines available, and the route of administration preferred.

It is strongly recommended that you get your chicks vaccinated for Marek's disease at the hatchery. A coccidiosis vaccine can also be given at the hatchery to help the chicks develop immunity to the parasite that causes coccidiosis, which is a common problem with floor-raised chickens. Typical vaccines given throughout the growing of replacement pullets include those for Infectious Bursal Disease, Newcastle Disease, Infectious Bronchitis, Fowl Pox, and Avian Encephalitis. Do not vaccinate for a disease unless you are at risk of developing the disease

An example of vaccination program for replacement pullets would be as follows:

Day 1 – Marek's Disease given by injection at the hatchery

Day 18 – Infectious Bursal Disease (IBD) in the water

Day 24 – IBD vaccine and a combined Newcastle/Bronchitis vaccine in the water

Day 30 – IBD in the water

Week 6 – Newcastle/Bronchitis spray

Week 10 – Avian Encephalitis (AE) and Newcastle/Bronchitis vaccines given as a spray

Week 13 – Fowl Pox given by wing web, and Newcastle/Bronchitis given via injection

Week 15 – Newcastle/Bronchitis vaccine by spray.

Do not vaccinate unless you have disease present in your area. Unless you know how to vaccinate your flock properly, it is best not to vaccinate. For example, never vaccinate day-old chicks for infectious Bronchitis because it will impair the development of the reproductive tract.

Salmonella enteritidis has the ability to colonize the internal organs of chickens without making the chickens sick. It is possible, therefore, for a healthy-looking hen to lay eggs contaminated with *Salmonella enteritidis* which can cause food poisoning if the eggs are not handled properly. Good farming and hygienic practices are the basis for successful control of *Salmonella enteritidis* in poultry farms. This includes all aspects including feed, hens, management, cleaning and disinfection, control of rodents, etc. Vaccination of chickens is an additional tool that can be used to increase hen resistance to Salmonella and reduce *Salmonella enteritidis* shedding. There are different types of Salmonella vaccines available. A spray vaccine can be given at the hatchery or shortly after arrival at the farm. A second dose is given in the drinking water two weeks later. Another version of a spray Salmonella vaccine is sprayed on the flock at 2, 4, and 16 weeks of age. An injectable vaccine can be given at 4 weeks of age and repeated before the pullets come into production. The use of Salmonella vaccine is heavily regulated by the state veterinarian's office.

It is important to develop an overall vaccination program specifically suited to your farm and local conditions. ***Do not vaccinate if there is no risk of the disease***. Consult your veterinarian.

Summary

Raising your own replacement pullets gives you better control over the growth, condition, and development of the laying flock. Pullets are raised to reach a target weight by a specific age. It is important to know what that weight is and monitor the progress by weighing a random sample of pullet chicks weekly starting at two to three weeks of age. Chickens lay in response to the number of hours of light in the day. It is important to follow a lighting program with the replacement pullets so that they can be stimulated to come into production at the correct time and weight. Vaccines other than Marek's and coccidiosis should not be done unless the disease is prevalent in your area.

Minor revision 10-2022